SF/AR
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**From:** "Stefanoff, Jim/SPK" <jstefano@CH2M.com>
**To:** "Gruenenfelder, Chuck/SPK" <cgruenen@CH2M.com>
**Date:** 3/31/99 1:31pm
**Subject:** FW: Bunker Hill Mine Storage Questions

Hello Chuck, here are Ken Trotman's thoughts on the approach for the mine water/reiver elevation/leakage evaluation. Jim.

> -----Original Message-----
> From: Stefanoff, Jim/SPK
> Sent: Friday, February 26, 1999 2:34 PM
> To: 'Voytilla, Mary Kay/EPA'
> Cc: Germon, Matt/SPK; Trotman, Ken/SEA; 'Riley, John/Pyrite Hydrochem'
> Subject: FW: Bunker Hill Mine Storage Questions
>
> Hello Mary Kay. The attached message from Ken Trotman (a hydrogeologist in
> our Seattle office) describes recommendations for further evaluating the
> mine water elevation/river level issue. He suggests a phased approach as
> follows:
>
> Phase 1: Gather information on wells and water levels in the area from the
> mine to the river
>
> Phase 2: Plot up a water level map to confirm that the aquifer behaves
> accordingly with his conceptual model of a typical river valley
>
> Phase 3: Perform simple Darcy Law calcs if justified to increase the
> certainty about the conceptual model of the valley aquifer
>
> Phase 4: Perform simple 2-dimensional modeling if justified to increase
> the certainty about the conceptual model of the valley aquifer and to
> allow "what if" estimates of leakage rates to the river if the mine water
> filled to the point of a positive gravity head to the river from the mine
> (e.g. complete treatment system failure for a long time or periodic
> excursions when the mine water increases from 10 Level up towards 9
> Level).
>
> The major uncertainty for any Darcy or 2-D modeling will be the hydraulic
> conductivity of the fracture flow. We would likely approach the
> uncertainty by looking at a range of conductivities from very conductive
> to hardly conductive.
>
> Lets talk about this phased approach, Ken can join in to help answer any
> questions. Thanks, Jim.
>
> -----Original Message-----
> From: Trotman, Ken/SEA
> Sent: Friday, February 26, 1999 1:52 PM
> To: Stefanoff, Jim/SPK
> Subject: Bunker Hill Mine Storage Questions
>
> Jim, this e-mail summarizes my thoughts and recommendations on the
> questions you posed. I've reviewed the information you have sent and will
> start by answering a simplified version of your question: can we use the

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> mine as storage by flooding 11 level and still have confidence that the
> mine water will not move to the river? Based purely on the head
> differences between the river surface and the dewatering level in the mine
> the answer is yes (but I would not be willing to put that in a document
> yet). As noted in the Presumptive Remedy Report, the mine water elevation
> is currently maintained at about 270 feet below the river. Flooding 11
> level would reduce this elevation difference to approximately 70 feet. In
> theory, the mine dewatering activities (with 11 level flooded) will still
> serve as a groundwater containment system in the vicinity of the mine and
> the elevation differences would suggest the dewatering is creating a
> hydraulic gradient reversal somewhere between the river and the mine
> (i.e., groundwater is moving back towards the mine, not towards the
> river).
>
> With that said, let's talk about uncertainties. My conceptual
> hydrogeologic model at this point is a shallow river aquifer system
> consisting of alluvial material above a regional fractured bedrock aquifer
> system. I'm assuming that bedrock groundwater discharges to the valley
> alluvial system and that there are no hydrogeologic "quirks" between the
> mine and the river (i.e., there is a smooth head distribution between the
> groundwater in the upland areas near the mine down to the river). This
> conceptual model is a "typical" system but I'm not certain it applies
> specifically to the bunker hill area. My recommendation to reduce this
> uncertainty is to do a quick well inventory from the bunker hill area down
> to the river - both bedrock wells (if there are any) and shallow alluvial
> wells. The key is finding well logs with water level measurements and
> then putting together a potentiometric/water table map. We should also do
> a report search to see if the USGS or State has done any groundwater
> characterization work in this area (Water Supply Papers, etc.). The water
> level map may wind up being pretty crude with data gaps but I would hope
> we could pull together enough data to show the hydrogeologic system does
> fit the "typical" or expected model. With this supporting argument in
> hand (the map), we would have a lot more certainty that the simple head
> comparison approach to answering your question holds water (sorry, I
> couldn't resist). Once we have our document/well search complete, I would
> anticipate about a one day effort for a junior hydro to put together a
> working draft of the map (amount of effort would be dependent on quantity
> and clarity of data found).
>
> I talked to John Riley about this and he thought the well inventory and
> head distribution map would be a good approach. He indicated that the U of
> I put some wells down in the Smelterville Flat area that might be helpful.
> He also suggested that if we get done with this effort and we find our
> uncertainties are still too large, we might want to consider using a
> simple 2-D analytical model to evaluate the dewatering influences and how
> they relate to the river. I think this is a good idea but am concerned
> that we might not have the aquifer input parameters for the model. We
> could probably bound the problem with a likely range of parameters to give
> us best/worst case scenarios. If we can find adequate water level data to
> develop a good head distribution map, I don't think we will need to use a
> model. On the other hand, if you ask the question how far can you fill
> the mine up without impacting the river - the model would be a better way
> to approach the problem (assuming we had some good aquifer parameter
> data).

>
> Finally, we were talking about a catastrophic treatment plant failure and
> how long it would take for mine water to actually reach the river (or move
> beyond the capture zone of the dewatering system) if groundwater levels
> were temporarily allowed to exceed the river elevation by some amount.
> This travel time could potentially translate into additional storage
> capacity. As a first step, I'd recommend a quick Darcy calculation to
> estimate a linear groundwater velocity. This would give us an initial
> idea of the travel times and might tell us if it would be worth pursuing a
> better estimate with more sophisticated methods (read that as the 2-D
> model). The travel time to the river is a pretty straight forward
> calculation (with simplifying assumptions of course). The more
> appropriate, and conservative, approach may be to estimate travel times to
> the "edge" of the dewatering system capture zone. The premise being we
> would not want to allow the mine water to move beyond the area the
> dewatering system could contain - once it was turned back on. Coming up
> with an estimate of the extent of the dewatering system capture zone could
> be problematic - I'd need to go back and review more material to better
> understand the dewatering flow system.
>
> As you probably noticed, I did not give you a lot of details on labor
> hours to complete the recommendations. I would start with quizzing Riley
> about information sources before I could estimate the well data/report
> search effort. Once we have the information, I think the mapping would be
> about a one day effort (WORKING DRAFT ONLY). The Darcy calculations and
> the modeling both depend on aquifer parameter information. Again, I would
> start with a call to John before I could estimate the labor associated
> with that data search - John has more knowledge of the available hydro
> studies for this area than I do. After that, the travel time calculations
> (mine to river) are quick; an hour to do calcs and document assumptions
> and results; better make that two hours, we could wind up with lots of
> assumptions. The travel time calculation to the edge of the dewatering
> system capture zone and the modeling effort would be more involved. I'd
> estimate two or three days for a simple model evaluation.
>
> Hope this helps, give me a call if you have questions or need more
> clarification in this discussion. FYI, my time to review materials, talk
> to Riley, and do this short initial write-up is 4 hours. kt.
>

CC: "'Voytilla, Mary Kay/EPA'" <voytilla.marykay@epama...